The Scientific Review,

AND

SCIENTIFIC AND LITERARY REVIEW,

A RECORD OF PROGRESS IN ARTS, INDUSTRY, AND MANUFACTURES,

INCORPORATING THE

REGISTERED FOR TRANSMISSION ABROAD.] **Journal of the Inventors' Institute.** [ALL RIGHTS RESERVED.

VOL. XVIII.—No. 8.] AUGUST, 1883. [PRICE 6d.

SUBJECT MATTER INDEX OF APPLICATIONS FOR PATENTS.

June 15th to July 16th inclusive.

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⁂ *The above List is prepared from the Patent Records by Mr. T. Morgan, Secretary of the Inventors' Patentright Association, Limited.*

THE REFUSE OF FURNACES FOR BUILDING PURPOSES.

On the utilisation of the refuse material from blast furnaces for mortar for building purposes, Mr. W. Mattieu Williams, F.S.A., relates some interesting experiences. It is far from a new idea to make a conglomerate from the slag of a furnace for building purposes, and Mr. Williams thinks he has heard of its use in finer work, and he concludes from the chemical nature of the cinder heaps found around furnaces that their composition renders them well suited for many purposes where lime mortar is now used.

The slag refuse is composed of silicates of lime and alumina, intermingled with silicates of iron, manganese, and magnesia in variable proportions. When the silica is in excess they are glassy; when the proportion of lime is greater they are earthy. These earthy cinders pulverise spontaneously, and are those which, I believe, have been used directly for cement; but I should expect the best result from the glassy cinders (or "slags," as they are improperly called), as these contain sufficient silica to combine actively with the lime of mortar and thereby harden efficiently.

While on the subject I may mention a little device which I adopted in building the brickwork setting for the retorts, premising, however, that I began at this work quite as a novice, a purely amateur builder. At first I contracted in the usual manner with the bricklayer, at so much per cubic foot measured all over, I finding all materials, he only doing the work. The work was badly done in spite of all my vigilance, and the discharging of three or four bricklayers in succession, the fault being that the bricks were not laid closely enough, and the thick joints of mortar crumbled when the whole structure was heated. At last I found a remedy for this, which was very simple. Instead of finding *all* the materials I only found the bricks, leaving the contracting workman to supply his own mortar, and of course paying him accordingly. The difficulty of making each brick to rest in firm contact with its neighbour with no more mortar between each than was necessary for filling up inequalities of surface, immediately disappeared.

The patent of Mr. William S. Prosser, of Auburn, Cal., relates to an improved method of feeding straw as fuel to the furnaces of traction engines. The invention consists in a device to be applied to combined "headers" and "thrashers" that are moved over the field and which cut and thrash the grain at one operation. A straw feed box is provided with reciprocating flexible bars, which connect the straw direct from the thrasher into the furnace, where its consumption creates the power for driving the machines.

Reviews.

ESOTERIC BUDDHISM.

"Esoteric Buddhism." By A. P. Sinnett. London: Trubner and Co.

In reviewing these pages we are reminded of a remarkable work which has won numberless admirers amongst the native races of India, and is not without its numerous supporters both here and in America—we refer to "Isis Unveiled," by Madame Blavatski of Bombay. The works are identical, but the former reveals the road to which the latter paved the way. We are pleased to see that Mr. Sinnett pays a just tribute to "The Perfect Way,"[*] which he says proves "how more roads than one may lead to a mountain top." The philosophy of the teaching being somewhat similar.

On page 4 we read the following:—From Buddha's time until now the esoteric science referred to has been jealously guarded as a precious heritage belonging exclusively to regularly initiated members of mysteriously organised associations.

This is doubtless true. Matthew Arnold, in his "Light of Asia," has given us glimpses of the mystic meaning of this marvellous religion. But Mr. Sinnett has done much more; he has revealed to us the one grand truth of Buddhism, which so many students of Oriental literature, to some of whom we think at least we must award the intuitive knowledge of an underlying truth beyond their grasp, have for years sought in vain. Hitherto, neither Max Muller, Rhyds Davids, or Arthur Lillie, have done justice to this religion.

The decaying faiths of the world's history are more and more becoming the object of contempt and ridicule. Science has proved the fallacy of the creation as revealed by Moses, and day by day we are drawing nearer to a vortex of darkness which it would seem is ready to sweep all creeds from the face of the earth, at the sight of which even the most earnest theologians tremble.

If the strongest evidence of the truth of any revealed religion should be judged from the number of its followers, to Buddhism we must award the palm. It has stood the test of twenty three centuries, is rapidly increasing, and in its esoteric sense possesses the sublimest teachings, though full of complexities of detail. While the Christian and Mahommedan religions have been that of the sword, Buddhism without bloodshed, and full of mercy has steadily progressed supported with the purest principles of sublime love and truth.

Oriental philosophy must not be judged in the light of the western world; while they have worked on the spiritual we have worked on the physical plain; while they have regarded force and matter as identical, we have landed in a physical discussion as to its impossibility, and have viewed the power of the molecules in a totally different light. If life has been evoked from chaos, it is only by going back to the first great cause we can discover the truth, for behind the life impulse are to be traced the mineral, vegetable, and animal kingdoms. The disintegration and reintegration of matter have yet to be understood.

Nirvana and Devachan, the mystic states, which have hitherto baffled the student of Buddhism, are here fully explained and intensified to perfection in their relatively ethereal states.

If physical causes alone give rise to intellect, it may be that through this process man is less able to realize his spiritual existence, and until he accepts the latter from those who are able and willing to teach it, the veil of darkness will ever be drawn.

Mr. Sinnett very truly says: "One of the most embarrassing difficulties that beset the present attempt to translate the esoteric doctrine into plain language, is due really to the fact that spiritual perceptiveness, apart from all ordinary processes by which knowledge is acquired, is a great and grand possibility of human nature."

To follow this religion along its pathway entirely the ascent into the regions of spiritual elevation or Nirvana, and the descent into Avatchi with all their various degrees, would be almost an impossibility in this short review. The book must be carefully read to be understood, as the subject is quite new to western minds.

The following is an important paragraph as showing the nature of the religion:—"The most important element in the Buddhist reform has always been its social and moral code, not its metaphysical theories. That moral code, taken by itself, is one of the most perfect which the world has ever known, and it was this blessing that the introduction of Buddhism brought into Tibet."

The great cosmic night of the planetary chain reveals to us the most stupendous truth in the whole universe, and is, perhaps, the most marvellous revelation of Esoteric Science, and we need scarcely add that this science is wonderfully endorsed in the evolution of the present day, to which it will form a grand field for investigators. It remains to be seen whether the world is ripe for this revelation.

To the student of evolution at least it will open a new and wide field for investigation, and give the geologist, who has ever worked on the physical plain, many links to the chain of his discoveries; which have been hitherto unsupported by any revealed religion. In this light alone great facts are open to view. We refer to the Miocene, and Eocene or earlier tertiary deposits; the stumbling block to the theologist and the cogent argument of its votaries.

Time has taught us that truth is stranger than fiction, stranger in its subtler sense, but stronger in its sublime mysticism, as revealed in this book. To those who desire to seek and know the truth now given œons of time in the world's history, these pages will not fail to yield the jewels sought. Erudite research has sown the seed, but Mr. Sinnett has gathered the harvest. There is a potent charm throughout the work which enchants the reader with a profound feeling of veneration both for its author and the adept to whom he is indebted for the revelation. That the re-incarnation of the soul is taught in these pages as an absolute necessity in the progress of humanity is not surprising. It was the opinion of the earliest sages and is endorsed by some modern philosophers. The author puts this clearly before the reader, and when once acccepted, it must necessarily clear up so much that is painfully mysterious in this life. As the universe is boundless and its cosmogony a field for discovery, so is the whole of this religion in the facts it reveals. Natural analogies in the theory of evolution of modern science support it entirely. As is the transmigration of Buddhism so is the Darwinian development of evolution.

The whole volume is so full of that which is new and mysterious, that while giving the author credit for his lucid and admirable choice of language, we cannot but fail to foresee that there is yet much to be written before the cursory reader can grasp the mass of knowledge in its pages.

Mr. Sinnett deserves some share of attention; he is no mere tyro in literature; he is the author of the "Occult World," which has met with a more than average success both here and in India, and is also the editor of a Bombay paper. His modesty as the chosen instrument of the Tibet brotherhood in bringing this hitherto secret and sacred religion before the world for the first time, makes us believe in his sincerity. We have no hesitation in pronouncing it the most remarkable book on occult science of modern times, and we cordially wish it the success it deserves.

THE SMITHY AND FORGE.

"The Smithy and Forge." By W. J. E. Crane. Illustrated. Crosby Lockwood & Co.

The *Athenæum* in a notice of this work makes the following remarks:—Engineering, carpentry, masonry, &c., remarks Mr. Crane, have "scores of works, from expensive folios to popular duodecimos, devoted to their elucidation; but, so far as the author's knowledge goes, no English book on smith's work exists." To fill this wide gap the little volume before us contributes some useful chapters. But it is one thing to do this, and another to succeed in the preparation of even a rudimentary treatise on this most ancient branch of craftsmanship. The great thing to be borne in mind by the writer on such a subject is scale. To decide with what degree of detail the craft or the art treated is to be handled; to arrange such a division as shall be exhaustive without inequality, and as shall give a complete idea of the occupation without going into disproportionate detail in the particular branch with which the writer may happen to be most familiar—such are the requirements of literature. Such an ideal is, however, rarely conceived, or at all events rarely illustrated, by writers on any subject that has not been long threshed out by way of monographs and special treatises. The work of the smith, in its widest sense, embraces all hammer work in metal, although chiefly concerned with metal made ductile by heat. The title of smith comprehends the workers in gold, silver, copper, iron, and their alloys; and the antiquity of each branch of the art is probably in the order in which we have named the metals wrought. That historic order is no doubt mainly due to the fact that the occurrence of metal in the virgin state was what first directed the attention of mankind to its use; and thus the less refractory the ore, and the less heat required for the process of smelting, the earlier was the date at which each metal assumed its rank in the imperfect laboratory of early art. Without going into too much detail, some account of the different qualities of iron and steel, glancing at the immense improvements made of late in the production of the latter, should form an indispensable chapter in the history of smith-work. This is wanting in Mr. Crane's book. His first chapter is a sketch of the history of iron forging, which is fairly written to scale, although something should have been said of the earliest application of iron to warlike purposes in the form of arrow-heads. The chapters on the forge and blast, the fire, and the operations of forging are good and practical. Then the author comes down at once to the special work of the farrier. But he tells us nothing of the herculean work of the smithy, that of the anchor-smith, for example, nor of the manner in which the steam-hammer has given to Vulcan a power of which we are yet far from reallzing the full importance. There is an excellent chapter on ornamental iron-work, written, the preface says, by Mr. C. J. Hall; and a companion chapter, of practical value, on coach-smithing, by Mr. H. G. Witten, of Sheffield. In fact, the whole practical part of the book deserves commendation: and if the little book fails to deserve altogether the title of a "rudimentary treatise on smith's work," it gives very much that may be of present value to the smith, and of future utility to any writer who shall attempt a more comprehensive grasp and treatment of one of the most important as well as of the most ancient of human industries.

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[*] "The Perfect Way, or the Finding of Christ."

GLASS IN THE OLD WORLD.

"Glass in the Old World." By M. A. Wallace-Dunlop. Field and Tuer.

General readers no less than students ought to be thankful to Mr. Wallace-Dunlop and those who assisted him in gathering this extraordinary body of notes. America alone is, so far as we have observed, omitted, the only exception being that it is stated that obsidian was extensively used in Peru for mirrors and personal ornaments. Without pretending to be critical or to have satisfied himself about the veracity of numerous legends he has gathered, the compiler does good service even when he repeats the wild guesses of writers like Fosbroke, and supposes that certain hoops of glass found at Machynlleth may have been the stock in trade of a magician. Almost nothing has escaped the attention of the writer, who comments alike on the Incas' obsidian and the so-called Christian glass which Dr. Garrucci illustrated zealously. As to the latter material, Mr. Dunlop does well to contest the assumption of Cardinal Wiseman that these relics were made only by Christians; but he writes loosely when he states that the glass cups and discs of the catacombs are "generally ornamented with gold figures enclosed between two layers of glass, and the whole fused into one mass." Such designs were, in fact, etched in gold foil and enclosed between layers of glass. Modern forgeries of this *fabrique* are more easy to make than to detect, and they are numerous in cabinets of antiquities. The difficulty is to get rid of or prevent bubbles and striæ occurring in the glass.

As a gathering of odds and ends about glass, enriched with anecdotes and acute suggestions, rather than illuminated by new light, this book might have charmed Pliny and caused Sir Thomas Browne to fall on the author's neck. The subject is so vast and rich in details that the task of selection must have been almost as laborious as that of collection. The good sense of the writer may be judged by his remarks on the use of glass windows by the Romans:—

> "Glass must very soon have been substituted for talc, and the first real evidence of its use comes from Pompeii and Herculaneum; the Naples Museum contains various specimens, and it shows the extraordinary ignorance of such subjects which prevailed in the last century [and, let us add, much later], during which so many people disputed the existence of any proof that glass was anciently used for windows, when Dutens, 1778, states that the baths in Pompeii were glazed with as fine glass as in the present day; his book was evidently never read or not considered a veracious history."

We may demur to the declaration, as if the fact were unchallengeable, that certain antiquities found in graves in this island were introduced by Tyrians or Carthaginians; but there is an undeniable charm in the many legends which hang about the finding of beads in tombs, Theban as well as British. In this respect the chapter on these ornaments is most attractive, for it embraces the *ovum anguinum* of Pliny, its fellow the "mermaid's egg" of Bishop Gibson, the Cornish *glain neidyr*, the Druid's beads of many tales, and African "aggry beads"—objects which have turned up in many European, Asiatic, and African sites, and are fairly supposed to have been made by Sidonian craftsmen or their later representatives of Maurano. It is indisputable that such relics occurred in very ancient graves, and that tons of Venetian beads like them are annually sold in Cairo and Djedda. Among innumerable ancient toys, which lend a pathos to dry-as-dust researches, we may note the finding of drops of glass, not perforated like beads, in children's graves.

SONNET.

On viewing the picture "Memories," by Sir Frederick Leighton, P.R.A.

Within the liquid light of thy sweet eyes
Fond memories dwell of happiness and love.
And ever hover, gentle as the dove,
The mental pictures of thy mind, or rise
To skies where thy bright soul can idolize:
Soaring, 'mid happy dreams, to spheres above;
To sing with seraphs, or with angels rove,
Till thy pure spirit 'tween the ether lies!

Fresh is thy face, as rosy tints of morn,
Bathed in the beauty of her luscious light!
Thy eyes, twin stars that the fair heavens adorn;
Thy lips like buds that blossom to the sight.
To win love's love thou needst no magic wand,
That spell-bound charm lives in thy dainty hand.

Henry George Hellon.

MICROSCOPIC EXAMINATION OF PRINTED COTTON GOODS.

By Richard Meyer.

"Fast colours" on fabrics are, as everybody knows, produced when a solution of the dye, or the materials from which it is formed, penetrate the fibre in a soluble state and are then rendered insoluble *within* the fibre. The substance of the fibre itself may take an active part in the formation of the precipitate, or the fibre may serve merely as the vessel in which precipitation takes place, allowing the solution to enter freely, but encircling the precipitate formed therein, and to a certain extent holding it prisoner.

This may take place during the operation of dyeing, or, which is very common in calico printing, may be accomplished by printing first and then steaming. In recent times these "steam colours" have been gradually gaining ground, artificial alizarine having contributed not a little thereto. But among these there is a different class, the fixing of which depends on a totally different principle; these are called the "albumen colours." These serve the purpose of rendering colours useful which, owing to their insolubility, or their utter indifference to cotton fibres, could not otherwise be employed for calico printing. These dyes are first mixed with a solution of albumen, then printed upon the goods, and afterward steamed. This coagulates the albumen, which sticks the dye fast to the fibre. The union is a very intimate one, and if the dye itself is permanent, perfectly fast colours can be obtained in this manner. This method is particularly useful for aniline dyes and certain mineral colours like ultramarine, Guignet's green, &c.

In the examination of printed cottons to ascertain what dyes have been used and how they were made, the question frequently arises as to whether the dye was formed within the fibre or was used already made and fixed with albumen. Both methods can be employed under different circumstances with one and the same dye. For example, it is a very common method of procedure to impregnate the fibre with a soluble salt of lead, to precipitate this as hydrate, carbonate, or sulphate, and then convert this into a fiery orange red basic chromate of lead. In combination with steam colours, however, it is far more convenient to print the "chrome-orange" with albumen and then fix it by steaming. How can we tell which of the two methods has been employed?

The first thought would be to test for the presence or absence of albumen. The affinity that albumen has for organic dyestuffs, and which is wanting in cotton fibres, might offer a means of doing so. But when goods dyed with chromate of lead are put in a solution of such a dye, it is found that, whether albumen is present or absent, more or less of the dye is fixed to the spot where the lead is, causing a dirty colour, so that no sharp distinction can be made in this way.

A glance through the microscope offers a rare surprise. By macerating some of the tissue with a needle so that we can see the individal fibres of cotton, they will be seen to be uniformly dyed throughout the whole mass and transparent. In many dyes little granules are seen, but the characteristic form of the fibres is unaltered and distinctly recognizable, with the dyestuff deposited uniformly everywhere *within* it.

With the albumen process it is quite different. The fibres are seen to be totally uncoloured. In numerous places there are little single coloured shreds of coagulated albumen, adhering to the *outside*. Little isolated groups of shreds can also be seen here and there in the field of view, having been separated from the fibre by maceration.

When chromate of lead has been fixed with albumen, the flakes of albumen and pigment will appear opaque and almost black in transmitted light, but distinctly red by reflected light. Ultramarine attached with albumen forms beautiful transparent light blue flakes, but otherwise has the same character as the chromate.—*Berl. Berichte*, 1883.

PERILS OF THE STUDIO.

A contemporary directs attention to certain dangers which attend the art of painting, or, rather. which may attend the practice of that beautiful art, if habits of carelessness and uncleanliness are formed, especially in the case of young females who take to painting either as a pastime or a profession. The censor cited warns his readers, first, against putting the brush in the mouth to make a fine point, and, second against leaving the handles of the brushes dirty, so that when several are held together in the hand the paint may be absorbed and poison the system. He enjoins the entire avoidance of brush pointing with the mouth, and the perfect cleaning of bushes before they are put away. In support of his argument our contemporary refers to certain instances of injury which have recently occurred. It is needless to say that perils of the class named actually exist. If an onlooker will take the trouble to count the number of times an amateur artist or beginner puts the brush in the mouth during one-quarter of an hour, the result will make it clear that a considerable amount of lead or other poisonous material may be taken into the system by this process. As to the alleged absorption through the skin of the hand, we do not remember to have seen an instance of wrist-drop in an artist arising from this cause, but it is quite conceivable that such cases may occur. It will therefore be well to bear the warning given in mind, and to avoid practices which may, under certain conditions, prove mischievous. There is another small matter which should be mentioned in this connection. It is a mistake to keep the left hand burdened and cramped by a heavy palette and a bundle of brushes with the rest-stick in oil-painting. The hand gets cramped and painful. It is possible that in some cases a paralytic disability not unlike writer's cramp may be induced by this mismanagement. The practice might, though not perhaps easily or conveniently, be avoided.

THE AMENDMENTS IN THE PATENT BILL.

THE Bill, as amended by the Standing Committee, has been reprinted. In its new form the part of it relating to patents for inventions shows many important alterations, though in details only, the amendments having scarcely touched any of the main principles of the original measure.

As regards the method of application for patents no great changes have been effected in the original scheme. Provision is made for joint application by several persons, of whom one or more may be the actual inventor, and the rule that the provisional specification was to contain precise claims has been struck out. The proposed system of examination into applications has been modified in several particulars. The examiners are not to inquire into "subject matter," that is to say, to report whether the invention is a proper subject for a patent; they are only to see that the proper forms are complied with, and that a proper description of the invention is supplied (strangely enough the examination into this point is still limited to the provisional instead of being extended to the complete specification). They are, however, to report if they find two applications for protection for the same invention, and in such a case both applicants are to be informed. Provision is made for the keeping secret of the examiners' reports, even in the case of an action at law.

The provisions for opposition to grants of patents are the same as in the original Bill, but opposition is limited to two grounds (1) that the person opposing has been robbed of the invention; (2) that there already exists a patent for the same invention. It will be noted that this last provision practically opens up the whole question of novelty, and might enable a rival trader to force an applicant to defend the novelty of his invention in its very earliest stages. In the case of a capitalist pitted against a poor inventor it is easy to see the hardship of such a proceeding.

No changes are made in the fees, but an alternative scale is given under which they may be paid annually. This scale is so arranged that a patentee whose patent lapsed at the seventh year period would pay slightly less in annual fees than if he paid a lump sum in advance.

The practice of "racing for the seal," as it is called, that is, the attempt by a later applicant to get his patent sealed before an earlier applicant, and, therefore, effective against him, is clearly done away with in the amended Bill. In the Bill as drafted this was not quite certain.

The question of amendment is treated more liberally than it originally was, rather wider powers being given to the patentee.

A new clause has been introduced rendering patents effective as against the Crown. This, it will be remembered by those who followed the account of the proceedings in Committee, was carried against Mr. Chamberlain, and perhaps there are still hopes that this clause will not become law, because no corresponding alteration has been made in the form for the grant of a patent in the schedule. There the rights of the Crown are still maintained intact. The clause itself is similar to one in Sir John Holker's 1879 Patent Bill.

In the section devoted to legal proceedings there is inserted a new clause providing a remedy for groundless threats of such proceedings. In the miscellaneous section also there are one or two fresh clauses. Among these will be found provision for the case of an inventor who dies without applying for a patent, while another sub-section instructs the Patent Office to keep on sale copies of specifications of all existing patents. This clause would be improved by the omission of the word "existing," as it is difficult to see why the Office should not resume the practice, discontinued a few years ago, of keeping in print all specifications alike.

The alterations in the governing body of the Patent Office, proposed in Committee, were not pressed in consequence of Mr. Chamberlain's opposition, but the various modifications in the system, under which much originally left to the law officers would now be transferred to the Controller, will probably, to a great extent, meet the wishes of those who were anxious that the importance of the department should be secured by investing its head with, as far as possible, an independent authority. The autocracy of the Controller is, however, tempered by a provision that he is not to exercise his powers adversely to an applicant without first hearing him.

One more provision there is of considerable importance. In case of international arrangements being effected for the protection of inventions, a foreign patentee is to have priority over other applicants if he applies within six months of the date of his foreign application. This rule is, however, only to apply to foreign States with which international arrangements have been made. In all other cases it may be assumed that the legal interpretation of invention will still apply, and that the man who imports an invention at his own cost and risk from the distant shores of France or Holland will still, in the eye of the law, be the "first and true inventor."

There are many other minor alterations, but probably the above include the most important of those dealing with patents.

HOW SCREWS ARE THREADED.

SCREW threads are "originated" in the lathe usually. All lathe turning, with regular—constant—feed of the turning tool, is screw cutting, or threading; the tool cuts a spiral around a revolving cylinder.

It is evident, therefore, that by increasing the speed of the feed relative to that of the revolving cylinder, and having the point of the cutter properly shaped, a screw thread would result, instead of a paring off of the entire surface of the cylinder. All important actuating or working screws, as those for feeding on machine tools, are formed in this way, and large numbers, also, of ordinary machine screws, which when once seated are expected to remain *in situ* until the machine or implement of which they form a part is worn out.

Wood screws, as screws for fastening wood to wood, metal to wood, &c., are threaded in a similar manner, the thread being cut from the solid by a single cutter removing the material between the threads.

Large numbers of screws are threaded by dies, which may be called hollow screws, or nuts with cutting edges. These, by rotating, form the feed as well as the cutting device for threading the smooth cylindrical rod or bar. Some of these dyes are worked by hand, others by power, but in either case the cut, by the modern and improved dies, is clean, and the thread is formed from the solid. The old fashioned dies were adjustable so as to be "set up," and could be made to cut several sizes of diameters. Much of their work was done by pressure, or squeezing, and a part of the thread was "raised" instead of being cut from the solid material. There are adjustable dies made now, but they are so formed as to do solid cutting.

There is another method of cutting threads direct from the solid, and that is by milling. It is the invention of the late Eli Horton, the chuck man of Windsor Locks, Conn. The machine is entirely automatic, the blank to be cut being rotated as in a lathe, and a rotary milling tool rotating against it at an angle adapted to the pitch of the thread desired. As the blank revolves slowly toward the cutter, the cutter revolving more rapidly forms the thread by being fed along over the blank as is the cutting tool in a lathe. The milling tool is so formed in cross section as to produce any shape of thread desired. This method is still in use by the successors of Mr. Horton to thread the steel screws of their chucks.

Threads on large cast-iron screws are sometimes formed simply by being cast, and formerly there was much cheap small work of that sort in the market.

Threads may be raised by forging in dies, and some good work by this is produced. In both these cases, however, an after finish in the lathe is desirable.

For some peculiar purposes threads are formed by twisting a square or a flat bar; a common form of hand drill that has superseded the bow drill being a case in point. The stock of this drill is a bar, square in cross section, twisted, and which is rotated by sliding a loosely fitting nut rapidly back and forth over its length. A familiar instance of a screw thread of this description is the ordinary auger or bit, the cross section of which is a flattened parallelogram like a flat bar.

One peculiar method of forming screw threads remains to be mentioned. It is that of raising a thread by rolling between dies under pressure. There is a great deal of what is known as "bright wire goods" in the market, which are threaded. In many cases these threads are formed by simply rolling—one revolution, or a little more—the wire between two hardened steel plates that are corrugated spirally to form, when combined, a continuous thread. Sufficient pressure is applied during the rolling—which however, is very rapid—to raise the metal from the annealed wire enough to make a thread. In this case the threaded portion is considerably larger than the stock or wire, at least half the depth of the thread on each side.

The threads in nuts are produced either by the "originating" method, cutting them in a lathe, by being tapped, or sometimes by being cast of soft metal, as brass, on a threaded core of hard metal, as iron or steel. But nuts are mostly threaded by tapping, running one, two, or three successive taps through them either by hand or in a power machine. Nuts of very thin material, as sheet brass for lamp tops, jar covers, &c., are formed simply by rolling between spirally corrugated rolls, a work analogous to "beading" on tin ware.

MORITZ GROSSMAN, in his Year Book for 1883, gives the following recipe for cementing rubber or gutta-percha to metal; Pulverised shellac, dissolved in ten times its weight of pure ammonia. In three days the mixture will be of the required consistency. The ammonia penetrates the rubber, and enables the shellac to take a firm hold, but as it all evaporates in time, the rubber is immovably fastened to the metal, and neither gas nor water will remove it.

One of the most simple car coupling devices that has recently been patented is that of Mr. A Wells Case, of South Manchester, Conn. The invention consists in coupling heads having their sides beveled to adapt to overlap each other, and in unequal armed U-shaped coupling rods having curved bars attached to the ends of their long arms. The said rods couple the cars by the coupling head of an adjacent car when the cars are run together.

Mr. Joseph Marion, of Brooklyn, N.Y., has patented an improvement in oil stoves for family use consisting of an open bottom or tray upon which is placed asbestos fibre or similar material, to which the oil is supplied for burning. The supply of oil to the asbestos is regulated by the weight of the oil on the tray. A valve and counter balanced weight regulate and effectually seal the pipe and prevent any flow of gas to the tray.

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AND

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ARTS, INDUSTRY, AND MANUFACTURES,

INCORPORATING THE

JOURNAL OF THE INVENTORS' INSTITUTE,

(*Established* 1865.)

Is published on the first of every month at the

OFFICES, 21, COCKSPUR STREET, CHARING CROSS, LONDON, S.W.

The Scientific Review will be sent post free on prepaymen-of the Annual Subscription of 6s. 6d.; or it may be had wholesale from Messrs. KENT and CO., Paternoster Row, or through any Bookseller or Newsagent in the kingdom, price 6d. per copy. Single copy post free from the office, 6½d.

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SESSION 1882—1883.

If any meeting be held special notice *per post* will be supplied.

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Subscriptions are payable to Mr. G. A. Stretton, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts.

Proceedings of the Institute.

At a meeting of the Executive Council held on July 5 Major **Deane** was appointed Secretary, subject to confirmation at the next General Meeting.

Monthly Notices.

Mr. Peter Spence died on the 5th of July at his residence, Old Trafford, Manchester. He is generally known as a chemical manufacturer merely: but as an original investigator and discoverer he held an important position, especially in the applications of chemistry to important industries. He has long been regarded as one of the best practical chemists of the day.

The late Prof. Palmer's "Concise Dictionary," together with a simplified grammar of the Persian language, English-Persian part, edited, from the manuscript left imperfect at Prof. Palmer's death, by Mr. Guy Le Strange, will probably be ready for publication in October. The publishers will be Messrs. Trubner and Co.

The fifteenth annual session of the American Philological Association was held at Wesleyan University, Middletown, Connecticut, commencing on Tuesday, July 10th, at three o'clock P.M. The address by the President of the Association, Prof. M. W. Humphreys, of Vanderbilt University, Nashville, Tenn., was delivered on the Tuesday evening.

Prof. Huxley has accepted the office of president of a union of science and art teachers, and Prof. Roscoe is one of the vice-presidents. The headquarters of the union being in Manchester, district branches are to be organised.

With reference to the forthcoming International Exhibition at Calcutta, a Bill has been introduced into the Supreme Legislative Council of India for the purpose of protecting inventions sent to the exhibitions in India. It had been brought to the notice of Government that without some such law owners of unpatented inventions might be deterred from exhibiting.

Dr. D. Tommasi, in *Cosmos Les Mondes* for June 30th, produces a passage from the *Ristretto dei Foglietti Universali* of August 3rd, 1802, which he thinks gives the discovery of electro-magnetism to J. D. Romagnosi. This appears to show that Romagnosi observed the deflection of the magnetic needle by a galvanic current in may of this year.

Mr. Joseph Le Conte in the *American Journal of Science* for July has a valuable paper "On the Genesis of Metalliferous Veins," founded on his study of the solfataric action at Sulphur Bank and Steamboat Springs, in which he endeavours to disprove the position of Dr. F. Sandberger that all lodes are formed by deposits from solutions. The conclusion at which attentive observers have arrived is that many causes, widely different in their character, may produce similar results in the fissures of the earth.

Prof. J. E. Spanoge, of the Royal Athenæum, Antwerp, supposes that colliery explosions are more frequently due to the minute particles of coal dust floating in the air than to carburetted hydrogen escaping from the coal. He recommends that jets of steam should be employed in the levels to lay hold of the dust and deposit it in a harmless condition.

An influential meeting of the chemical trades of London was held at the London Chamber of Commerce on the 23rd of July, when it was resolved to form a society of four sections, the first composed of analytical chemists and scientific societies, the second of chemical manufacturers, the third of chemical brokers, merchants &c., and the fourth of druggists and drysalters. The object of this society is to raise the standard of those important trades. A large cammittee was nominated, of which Mr. David Howard was elected chairman. A general meeting of all interested was held on the 30th of July.

Dr. Cargill G. Knott, Secretary of the Edinburgh Mathematical Society, has beeen appointed Professor of Physics in the Imperial University of Tokio, Japan.

Prof. Rucker, Professor of Physics in the Yorkshire College at Leeds, will in future bear the title of the Cavendish Professor of Physics, the fund (£7,500) required to endow this chair having been contributed.

M. Adams has successfully established an optical telegraph between the islands of Mauritius and Réunion, a distance of 245 kilomètres. Observers in Mauritius can read the signals without difficulty, and the arrangements for announcing cyclones are in process of completion.

THE SCIENTIFIC REVIEW
AND
Scientific and Literary Review
INCORPORATING THE "JOURNAL OF THE INVENTORS' INSTITUTE."

AUGUST, 1883.

PATENTS BILL, 1883.

It will be satisfactory to our readers to hear that the Patents Bill introduced by the Government has every chance of coming into force at the beginning of next year. The synopsis of the Bill was given in the April number of the Scientific Review. The amendments made to the Bill in the House of Commons have been comparatively few, and are in a great measure improvements. The principal amendments are given in an article on page 89.

Another important amendment relates to the deferred fees at the fourth and seventh years. Although these fees are not in the aggregate reduced, yet it may be found beneficial in keeping in force the patents secured by inventors who are not in a position to pay the £50 at the fourth year or the £100 at the seventh year in one sum, as stipulated in the Bill originally issued.

In its passage through committee of the House of Commons the following alternative scale was agreed upon. The first charge of £4 is still retained, but in lieu of the fees of £50 and £100 the following are the annual fees :—

Before the expiration of	fourth	year from	date of patent...	£10
„	fifth	„	„	10
„	sixth	„	„	10
„	seventh	„	„	10
„	eighth	„	„	15
„	ninth	„	„	15
„	tenth	„	„	20
„	eleventh	„	„	20
„	twelfth	„	„	20
„	thirteenth	„	„	20

Although the charges for a patent are out of all proportion to the benefit the country derives, still inventors must persevere at least in securing a great reduction in the fees levied, even according to this Bill.

In reviewing the figures above given we can only say that, taken in contrast with the fees in most Continental countries, they compare favourably on the initial stage, but not otherwise. Further, taking the United States, where the sum of £7 is not only found sufficient but affords a gain to the revenue of many thousands of dollars, the statement made in the Grand Committee that there will be a loss to the revenue at the initial stage, in view of that obtained in the United States, is, we contend, not borne out by facts. For the number of applications that will be made will undoubtedly equal in numbers those taken out in the United States.

Another question that may be asked is, where is the staff necessary to carry out the provisions of the new Bill to be accommodated? Certainly not in the present building. Therefore it would be well if the scheme set before the Government by the Inventors' Institute in 1866 were considered, namely, having one building sufficient not only to give the necessary space for the staff, but also space for a Patent Museum, and thus do away with the dingy building now spoken of as the Patent Museum, which is a standing disgrace to the country.

In conclusion we would say that for what has been given by the Bill we can only express our thanks, and in addition hope that the Government may at an early period see its way to materially reduce the deferred fees charged by this latest effort in Patent Law legislation.

Since writing the above we have great pleasure in informing our readers that the Bill has passed the third reading in the House of Lords, and now only awaits Report and Royal Assent.

ELECTRICAL TRANSMISSION AND STORAGE.

By Dr. C. WILLIAM SIEMENS, F.R.S.,
Memb. Inst. C.E.

[From a recent Lecture in London before the Institute of Civil Engineers.]

DR. SIEMENS, in opening the discourse, adverted to the object the Council had in view in organising these occasional lectures, which were not to be lectures upon general topics, but the outcome of such special study and practical experience as members of the Institution had exceptional opportunities of acquiring in the course of their professional occupation. The subject to be dealt with during the present session was that of electricity. Already telegraphy had been brought forward by Mr. W. H. Preece, and telephonic communication by Sir Frederick Bramwell.

Thus far electricity had been introduced as the swift and subtile agency by which signals were produced either by mechanical means or by the human voice, and flashed almost instantaneously to distances which were limited, with regard to the former, by restrictions imposed by the globe. To the speaker had been assigned the task of introducing to their notice electric energy in a different aspect. Although still giving evidence of swiftness and precision, the effects he should dwell upon were no longer such as could be perceived only through the most delicate instruments human ingenuity could contrive, but were capable of rivalling the steam engine, compressed air, and the hydraulic accummlator in the accomplishment of actual work.

In the early attemps at magneto-electric machines, it was shown that, so long as their effect depended upon the oxidation of zinc in a battery, no commercially useful results could have been anticipated. The thermo-battery, the discovery of Seebeck in 1822, was alluded to as a means of converting heat into electric energy in the most direct manner; but this conversion could not be an entire one, because the second law of thermo-dynamics, which prevented the realisation of mechanical force of more than one-seventh part af the heat energy produced in combustion under the boiler, applied equally to the thermo-electric battery, in which the heat, conducted from the hot points of juncture to the cold, constituted a formidable loss. The electromotive force of each thermo-electric current did not exceed 0·036 of a volt, and 1800 elements were therefore necessary to work an incandescence lamp.

A most useful application of the thermo-electric battery for measuring radiant heat, the thermo pile, was exhibited. By means of an ingenious modification of the electrical pyrometer, named the bolometer, valuable researches in measuring solar radiations had been made by Prof. Langley.

Faraday's great discovery of magneto-induction was next noticed, and the original instrument by which he had elicited the first electric spark before the members of the Royal Institution in 1831 was shown in operation. It was proved that although the individual current produced by magneto-induction was exceedingly small and momentary in action, it was capable of unlimited multiplication by mechanical arrangements of a simple kind, and that by such multiplication the powerful effects of the dynamo-machine of the present day were built up. One of the means for accomplishing such multiplication was the Siemens armature of 1856. Another step of importance was that involved in the Pacinotti ring, known in its practical application as the machine of Gramme. A third step, that of the self-exciting principle, was first communicated by Dr. Werner Siemens to the Berlin Academy, on the 17th of January, 1867, and by the lecturer to the Royal Society on the 4th of the following month. This was read on the 14th of February, when the late Sir Charles Wheatstone also brought forward a paper embodying the same principle. The lecturer's machine, which was then exhibited, and which might be looked upon as the first of its kind, was shown in operation: it had done useful work for many years as a means of exciting steel magnets. A suggestion contained in Sir Charles Wheatstone's paper, that "a very remarkable increase of all the effects, accompanied by a diminution in the resistance of the machine, is observed when a cross wire is placed so as to divert a great portion of the current from the electro-magnet," had led the lecturer to an investigation read before the Royal Society on the 4th of March, 1880, in which it was shown that by augmenting the resistance upon the electro-magnets a hundred-fold valuable effects could be realised, as illustrated graphically by means of a diagram. The most important of these results consisted in this, that the electromotive force produced in a "shunt-wound machine," as it was called, increased with the external resistance, whereby the great fluctuations formerly inseparable from electric arc lighting could be obviated, and that, by the double means of exciting the electro-magnets, still greater uniformity of current was attainable.

The conditions upon which the working of a well conceived dynamo-machine must depend were next alluded to, and it was demonstrated that when losses by unnecessary wire resistance, by Foucault currents, and by induced currents in the rotating armature were avoided, as much as 90 per cent, or even more, of the power communicated to the machine was realised in the form of electric energy, and that *vice versa*, the re-conversion of electric into mechanical energy could be accomplished with similarly small loss. Thus, by means of two machines at a moderate distance apart, nearly 80 per cent of the power imparted to one machine could be again yielded in the mechanical form by the second, leaving out of consideration frictional losses, which latter need not be great, considering that a dynamo-machine had only one moving part well balanced, and was acted upon along its entire circumference by propelling force. Jacobi had proved, many years ago, that the maximum efficiency of a magneto-electric engine was obtained when—

$$\frac{e}{E} = \frac{w}{W} = \tfrac{1}{2},$$

which law had been frequently construed by Verdet (Theorie Mecanique de la Chaleur) and others to mean that one-half was the maximum theoretical efficiency obtainable in electric transmission of power, and that one-half of the current must be necessarily wasted or turned into heat. The lecturer could never be reconciled to a law necessitating such a waste of energy, and had maintained, without disputing the accuracy of Jacobi's law, that it had reference really to the condition of maximum work accomplished with a given machine, whereas its efficiency must be governed by the equation—

$$\frac{e}{E} = \frac{w}{W} = \text{nearly } 1.$$

From this it followed that the maximum yield was obtained when two dynamo-machines (of similar construction) rotated nearly at the same speed, but that under these conditions the amount of force transmitted was a minimum. Practically the best condition of working consisted in giving to the primary machine such proportions as to produce a current of the same magnitude, but of 50 per cent greater electromotive force than the secondary; by adopting such an arrangement, as much as 50 per cent of the power imparted to the primary could be practically received from the secondary machine at a distance of several miles. Prof. Silvanus Thompson, in his recent Cantor Lectures, had shown an ingenious graphica method of proving these important fundamental laws.

The possibility of transmitting power electrically was so obvious that suggestions to that effect had been frequently made since the days of Volta, by Ritchie, Jacobi, Henry, Page, Hjorth, and others; but it was only in recent years that such transmission had been rendered practically feasible.

Just six years ago, when delivering his Presidential Address to the Iron and Steel Institute, the lecturer had ventured to suggest that "time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration, namely, the electrical conductor. Suppose water-power to be employed to give motion to a dynamo-electrical machine, a very powerful electrical current will be the result, which may be carried to a great distance, through a large metallic conductor, and then be made to impart motion to electro-magnetic engines, to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod 3 ins. in diameter would be capable of transmitting 1000 horse-power a distance of, say, thirty miles, an amount sufficient to supply one-quarter of a million candle-power, which would suffice to illuminate a moderately-sized town." This suggestion had been much criticised at the time, when it was still thought that electricity was incapable of being massed so as to deal with many horse-power of effect, and the size of conductor he had proposed was also considered wholly inadequate. It would be interesting to test this early calculation by recent experience. M. Marcel Deprez had, it was well known, lately succeeded in transmiting as much as three horse-power to a distance of 40 kilometres (25 miles) through a pair of ordinary telegraph wires of 4 millimetres in diameter, The results so obtained had been carefully noted by M. Tresca, and had been communicated recently to the French Academy of Sciences. Taking the relative conductivity of iron wire employed by Deprez, and the 3-inch rod proposed by the lecturer, the amount of power that could be transmitted through the latter would be about 4000 horse-power. But Deprez had employed a motor-dynamo of 2000 volts., and was contented with a yield of 32 per cent only of the energy imparted to the primary machine, whereas he had calculated at the time upon an electromotive force of 200 volts, and upon a return of at least 40 per cent of the energy imparted. In March, 1878, when delivering one of the Science Lectures at Glasgow, he said that a 2-in. rod could be made to accomplish the object proposed, because he had by that time conceived the possibility of employing a current of at least 500 volts. Sir William Thomson had at once accepted these views, and with the conceptive ingenuity peculiar to himself, had gone far beyond him, in showing before the Parliamentary Electric Light Committee of 1879, that through a copper wire of only half-an-inch diameter 21,000 horse-power might be conveyed to a distance of 300 miles with a current of an intensity of 80,000 volts. The time might come when such a current could be dealt with, having a striking distance of about 1·2 feet in air, but then, probably, a very practical law enunciated by Sir William Thomson would be infringed. This was to the effect that electricity was conveyed at the cheapest rate through a conductor, the cost of which was such that the annual interest upon the money expended equalled the annual expenditure for lost effect in the conductor in producing the power to be conveyed. It appeared that M. Deprez had not followed this law in making his recent installations.

Sir William Armstrong was probably the

first to take practical advantage of these suggestions in lighting his house at Cragside during night time, and working his lathe and saw bench during the day, by power transmitted through a wire from a waterfall nearly a mile distant from his mansion. The lecturer had also accomplished the several objects of pumping water, cutting wood, hay, and swedes, of lighting his house, and of carrying on experiments in electro-horticulture from a common centre of steam-power. The results had been most satisfactory; the whole of the management had been in the hands of a gardener and of labourers, who were without previous knowledge of electricity, and the only repairs that had been found necessary were one renewal of the commutators and an occasional change of metallic contact brushes.

An interesting application of electric transmission to cranes, by Dr. Hopkinson, was shown in operation.

Among the numerous other applications of the electrical transmission of power, that to electrical railways, first exhibited by Dr. Werner Siemens, at the Berlin Exhibition of 1879, had created more than ordinary public attention. In it the current produced by the dynamo-machine, fixed at a convenient station and driven by a steam-engine or other motor, was conveyed to a dynamo placed upon the moving car, through a central rail supported upon insulating blocks of wood, the two working rails serving to convey the return current. The line was 900 yards long, of 2 ft. gauge, and the moving car served its purpose of carrying twenty visitors through the exhibition each trip. The success of this experiment soon led to the laying of the Lichterfelde line, in which both rails were placed upon insulating sleepers, so that the one served for the conveyance of the current from the power station to the moving car, and the other for completing the return circuit. This line had a gauge of 3 ft. 3 ins., was 2500 yards in length, and was worked by two dynamo-machines, developing an aggregate current of 9000 watts, equal to 12 horse-power. It had now been in constant operation since May 16, 1881, and had never failed in accomplishing its daily traffic. A line half a kilometre in length, but of 4 feet $8\frac{1}{2}$ ins. gauge, was established by the lecturer at Paris in connection with the Electric Exhibition of 1881. In this case, two suspended conductors in the form of hollow tubes with a longitudinal slit were adopted, the contact being made by metallic bolts drawn through these slit tubes, and connected with the dynamo-machine on the moving car by copper ropes passing through the roof. On this line 95,000 passengers were conveyed within the short period of seven weeks.

An electric tramway, six miles in length, had just been completed, connecting Portrush with Bush Mills, in the north of Ireland, in the installation of which the lecturer was aided by Mr. Traill, as engineer of the company, by Mr. Alexander Siemens, and by Dr. E. Hopkinson, representing his firm. In this instance the two rails, 3 feet apart, were not insulated from the ground, but were joined electrically by means of copper staples and formed the return circuit, the current being conveyed to the car through a a T-iron placed upon short standards, and insulated by means of insulate caps. For the present the power was produced by a steam-engine at Portrush, giving motion to a shunt-wound dynamo of 15,000 watts=20 horse-power, but arrangements were in progress to utilise a waterfall of ample power near Bush Mills, by means of three turbines of 40 horse-power each, now in course of erection. The working speed of this line was restricted by the Board of Trade to ten miles an hour, which was readily obtained, although the gradients of the line were decidedly unfavourable, including an incline of two miles in length at a gradient of 1 in 38. It was intended to extend the line six miles beyond Bush Mills, in order to join it at Dervock station with the north of Ireland narrow gauge railway system.

The electric system of propulsion was, in the lecturer's opinion, sufficiently advanced to assure practical success under suitable circumstances—such as for suburban tramways, elevated lines, and above all lines through tunnels, such as the Metropolitan and District Railways. The advantages were that the weight of the engine, so destructive of power and of the plant itself in starting and stopping, would be saved, and that perfect immunity from products of combustion would be insured. The experience at Lichterfelde, at Paris, and another electric line of 765 yards in length, and 2 ft. 2 in. gauge, worked in connection with the Zaukerode Colliery since October, 1882, were extremely favourable to this mode of propulsion. The lecturer, however, did not advocate its prospective application in competition with the locomotive engine for main lines of railway. For tramways within populous districts, the insulated conductor involved a serious difficulty. It would be more advantageous under these circumstances to resort to secondary batteries, forming a store of electrical energy carried under the seats of the car itself, and working a dynamo-machine connected with the moving wheels by means of belts and chains.

The secondary battery was the only available means of propelling vessels by electrical power, and considering that these batteries might be made to serve the purpose of keel ballast, their weight, which was still considerable, would not be objectionable. The secondary battery was not an entirely new conception. The hydrogen gas battery suggested by Sir Wm. Grove in 1841, and which was shown in operation, realised in the most perfect manner the conception of storage, only that the power obtained from it was exceedingly slight. The lecturer, in working upon Sir Wm. Grove's conception, had twenty-five years ago constructed a battery of considerable power in substituting porous carbon for platinum, impregnating the same with a precipitate of lead peroxidised by a charging current. At that time little practical importance attached, however, to the object, and even when Planté, in 1860, produced his secondary battery, composed of lead plates peroxidised by a charging current, little more than scientific curiosity was excited. It was only since the dynamo-machine had become an accomplished fact that the importance of this mode of storing energy had become of practical importance, and great credit was due to Faure, to Sellon, and to Volckmar for putting this valuable addition to practical science into available forms. A question of great interest in connection with the secondary battery had reference to its permanence. A fear had been expressed by many that local action would soon destroy the fabric of which it was composed, and that the active surfaces would become coated with sulphate of lead, preventing further action. It had, however, lately been proved in a paper read by Dr. Frankland before the Royal Society, corroborated by simultaneous investigations by Dr. Gladstone and Mr. Tribe, that the action of the secondary battery depended essentially upon the alternative composition and decomposition of sulphate of lead, which was therefore not an enemy, but the best friend to its continued action.

In conclusion, the lecturer referred to electric nomenclature, and to the means for measuring and recording the passage of electric energy. When he addressed the British Association at Southampton, he had ventured to suggest two electrical units additional to those established at the Electrical Congress in 1881, viz.: the watt and the joule, in order to complete the chain of units connecting electrical with mechanical energy and with the unit quantity of heat. He was glad to find that this suggestion had met with a favourable reception, especially that of the watt, which was convenient for expressing in an intelligible manner the effective power of a dynamo-machine, and for giving a precise idea of the number of lights or effective power to be realised by its current, as well as of the engine power necessary to drive it; 746 watts represented 1 horse-power.

Finally, the watt-meter, an instrument recently developed by his firm, was shown in operation. This consisted simply of a coil of thick conductor suspended by a torsion wire, and opposed laterally to a fixed coil of wire of high resistance. The current to be measured flowed through both coils in parallel circuit, the one representing its quantity expressible in amperes, and the other its potential expressible in volts. Their joint attractive action expressed therefore volt-amperes or watts, which were read off upon a scale of equal divisions.

The lecture was illustrated by experiments, and by numerous diagrams and tables of results. Measuring instruments by Profs. Ayrton and Perry, by Mr. Edison and by Mr. Boys, were also exhibited.

ON INSENSIBILITY ARISING FROM A DEFICIENCY OF OXYGEN IN THE AIR.

By William Wallace, Ph.D., F.R.S.E., F.I.C., F.C.S.

The evil effects of breathing the air of crowded apartments were formerly ascribed to the existence in such air of an abnormal quantity of carbon dioxide, usually called carbonic acid gas, which was stated to be a deadly poison; but the views of chemists and physiologists in regard to this have been much modified of late years, and some authorities have gone so far as to express the opinion that it is not a poison at all, in the ordinary sense of the word. A little consideration will show that the effects resulting from breathing the air of a confined and overcrowded apartment cannot be due exclusively or even chiefly, to the presence of carbonic acid gas: for that gas, as well as the aqueous vapour of the breath, is formed at the expense of the oxygen in the air, which diminishes in constant ratio to the increase of the products of the combustion of our food. For every per cent of carbonic acid gas produced, there is a little more than 1 per cent of oxygen taken up. Allowing, then, that carbonic acid is to some extent detrimental to the system when breathed, the effects to which I have referred are, at least partly, due to the diminished proportion of oxygen; and there is the further complication of an atmosphere saturated with aqueous vapour, and contaminated with the undefined volatile organic emanations from skin and lungs, which give a peculiar and oppressive feeling of "closeness" to the overcrowded and unventilated room. I think, however, that physiologists are now agreed that the lethargy, amounting in extreme cases to coma, produced by breathing such air, results from deficient oxygenation of the blood; and it is a fair inference that the most important factor in the phenomenon is the lessened proportion of oxygen. The normal proportion of that gas is from 20·9 to 21 per cent of the air when freed from aqueous vapour; and Dr. Angus Smith has shown conclusively that this proportion cannot be altered, even to the extent of $\frac{1}{4}$ per cent without producing appreciable effects, while a loss of $\frac{1}{2}$ per cent gives rise to serious inconvenience, and air containing only 20 per cent of oxygen may produce grave consequences if breathed for a considerable time. On the other hand, a man can breathe, for a short time, an atmosphere containing only 16 per cent of oxygen and about 4 per cent of carbonic acid gas. When the deficiency of oxygen exceeds this to a sensible extent, a candle refuses to burn, and a man exposed to it is speedily overcome and becomes insensible.

In all ordinary instances of this kind there are the complications I have spoken of, and I have thought the Society would be interested in a case which came under my notice about six months since, in which there are no such complications.

In the construction of a railway bridge over the Forth, near Alloa, a number of iron cylinders were sunk in sections or rings of 6 feet diameter and several feet in height, and making up in all, when finished, about 60 feet. I will not go into the mechanical details of the construction of the cylinders, except in so far as to say that the sections were placed one on the top of the other in such a way that a rather wide space was left all round, which had to be filled up from the inside with a rusting composition, well known to engineers, composed of iron turnings mixed with a small quantity of flowers of sulphur, with the addition, in some cases, of a little powdered sal-ammoniac. This mixture, when wet with water, soon oxidises, and swells up so as to completely fill up the spaces into which it is thrust. At the Alloa bridge a considerable number of the cylinders had been erected, the most of the "rusting" having been done by one man, who mixed up the composition with water in a pail and applied it to the joints without being affected by it to any appreciable extent. On one day, however—I think about the beginning of May,—when there was a perfectly still, somewhat hazy atmosphere, and considerable heat without direct sunshine, this man was observed to become overpowered by some mysterious influence, and a companion descended by a windlass on the top to bring him up. He managed to get him propped up in the bucket, in which he was pulled up to the fresh air, when he soon revived, but his deliverer was in turn overpowered, and, falling back into a pool of water at the bottom of the cylinder, was drowned. One of the contractors now descended, taking care to fasten a rope to his body in case he, too, might be rendered insensible by the noxious gas, which was now supposed to be present at the bottom of the cylinder; and fortunately so, for he speedily succumbed, and was immediately pulled up by the rope.

On being consulted regarding this apparently mysterious occurrence, I at once saw that the theory of an accumulation of carbonic acid or other noxious gas at the bottom of the cylinder was untenable, for the bottom was covered with water, and no gas could have come up from the bed of the river without being seen bubbling through the water. A few experiments with the rusting composition, a quantity of which was supplied to me, clearly showed that it absorbed oxygen from the air with great rapidity, so that in one of my experiments a portion of air was deprived of its oxygen in ten minutes to such an extent that it would no longer support the combustion of a candle, and in two hours 16 per cent was absorbed. In another case, continued for a longer period, a loss of 20½ per cent occurred, or nearly the whole of the oxygen. At the same time the mixture became very warm, the temperature in one case rising to 156° F., while the iron oxidised and the mixture acquired a brown colour. I had no hesitation, therefore, in ascribing the accident to the absorption of the oxygen of the air in the cylinder by the rusting composition, coupled with the peculiar condition of the atmosphere, which, while it favoured chemical action between the oxygen and the iron and sulphur in the mixture, prevented the circulation of the air in the cylinder, which usually took place to a sufficient extent to prevent serious consequences. The deadly gas at the bottom of the cylinder was therefore nothing more nor less than the nitrogen which constitutes four-fifths of the bulk of our atmosphere, but which, deprived of its companion oxygen, is entirely unable to support respiration. We have in this unfortunate occurrence, by which one life was lost and others endangered, a justification of the German name of nitrogen, stickstoff,—which may be freely translated choke-stuff or choke-damp,—a name which in our language is applied exclusively to carbonic acid gas.

MATTER AND FORCE.

(Concluded from Page 75.)

We may now consider some of the different modes of motion or force we know to be such, bearing in mind that we have no conception of matter, except by force; and *vice versa*. We have gravitation, cohesion, the simple movements of bodies, sound, heat, light, electricity, chemical action, and to us most wonderful of all, life; these in turn may be summed up in the one word, *Energy*, of which they are simply so many different forms or manifestations.

Now supposing a rod of metal to move to and fro once a second, a distance of say 1-16th of an inch, sight would easily make us sensible of the motion or force exerted. But let this rate of vibration be increased to a speed of say 14 per second, and the eye will be unable to take cognizance of the motion, and touch becomes necessary to demonstrate the same to our sensibility.

If we further increase this speed to 17 or 18 vibrations per second, our hearing takes up the force, and a deep bass note is the result. As this speed is augmented, the sound rises higher and higher, until, if we have the means of producing about 40,000 vibrations per second, the piercing shrill scream which the previous rates of motion had produced would suddenly cease, and to us silence ensue. This strange result comes from the fact that the form of the human ear is not constructed to be capable of transmitting a higher speed of movement.

Nevertheless much higher rates of motion can be made manifest to man. It has been calculated that if we increase this speed of vibration to about 5 millions per second, we are again made conscious of the same in the form of a faint heat emanating from the object, and that at about 4 hundred billions per second light commences; first a deep red, then with further increase of speed, yellow, green, blue, and lastly violet. As these lights develope, however, with the speed, the heat at first felt fades away, and like sound at a lower rate of motion, ceases to operate as such.

If we follow the results of a further increase in speed, we find that when we reach about 8 hundred billions per second all light ceases, just as if no motion whatever were in operation, in manner like unto sound and heat. It thus appears that we may consider the different *modes* of motion as simply differences in speeds, and that what we know as chemical action, electricity, and even life itself, are, on ultimate analysis, merely varying rates of the one all pervading energy or motion of the particles of matter under consideration.

The form of force which most sensibly and constantly affects mankind from without is heat. We have already pointed out that gravitation and cohesion tend to bring the particles of matter closer and closer together, while the tendency of heat is to force them asunder. It will thus be seen that the combined activities of these two forms of force makes it possible for the various forms of matter to exist. If there were no force like unto heat, opposing that of gravitation and cohesion, the whole matter of the universe would doubtless rush together into one solid lump. On the other hand, if it were not for gravitation and cohesion, matter could only exist in the form of the free ultimate or impenetrable atoms of which all its penetrable forms are composed.

But given the two kinds of force, attraction and repulsion, and it becomes easy to see that an infinite number of forms of matter and force become possible to infinite power of design.

How tremendous to us are some of the manifestations of this mighty power of heat. Take our own sun, which is the chief source of heat to this planet. It has been calculated that the heat from every square yard of the sun's surface is equal to what would be produced by burning on that square yard 6 tons of coal every hour, which heat from each square yard would be capable of keeping constantly at work a 63,000 horse power engine. Pouillet has calculated that the heat of the sun is sufficient to melt every day a shell of ice round his surface 10½ miles thick. And so essential is that heat to us, that if the sun were withdrawn for a very short time from us, all life, as we usually understand the term, would cease. The first 48 hours would probably be sufficient to precipitate every vestige of moisture from the air, in deluges of rain and piles of snow, and from that point would set in a degree of cold from two to three hundred below the zero of Fahrenheit's thermometer—which no animal or vegetable we are acquainted with could resist for an hour, any more than it could the heat of boiling water for a like period.

The stupendous activities on the face of the sun demonstrate what a fearful force this heat is. Tongues of flame being often observed to rush up from the surface to a distance of 80 thousand miles, and occasionally as much as 200 thousand miles projected into space. These enormous masses of matter rising and falling such vast distances, necessarily produce frightful disturbance of the sun's surface, producing at times chasms therein, which in some cases measure 3 and 4 thousand miles deep. All this is possible because the sun has no solid or liquid state of surface like unto the earth; but is truly in a state of fusion or gas, and probably has no portion of his surface more dense than cloud. Whether the central orb, which we cannot see, is much more dense, we are not able at present with certainty to say.

Now although the sun may possibly be the indirect cause of all the heat on this earth, we have other forms of force directly producing heat. The chief of these are, vital action or life force, chemical action, as in combustion, and the various forms of mechanical motion, such as percussion, condensation, and friction. We have also a great source of heat in electricity. For example, in the intense heat of the voltaic arc the hardest substances melt, many of the metals instantly fuse, and even vanish in vapour; gold and silver leaf burn vividly, and platinum, one of the most refractory of metals, melts as readily as wax in a candle flame. All persons are familiar with the production of heat from mechanical sources. We know that iron becomes hot by constant hammering, and steel shot will often give out a flash of flame on striking the targets at which they are fired. All forms of friction produce heat, which may be well illustrated by rapidly sliding down a rope or pole, in which act the hands may be much burnt. Savages light their fires by rubbing together dry pieces of wood, and the friction of dried branches of trees, acted upon by the wind, has set whole forests on fire. Engineers and other persons acquainted with the working of machinery, are familiar with the heating of a shaft or bearing from want of lubrication. In chemical action there is an enormous source of heat, as may be instanced as follows:—Water, as is well known, is a combination of oxygen and hydrogen. Now 8 lbs. of oxygen burned with 1 lb. of hydrogen to form 9 lbs. of water, would evolve in the combination a heat so enormous, that if it were turned into mechanical force, would be sufficient to raise a ton weight to the height of nearly 4 miles. What undeveloped force is here waiting the use of man!

Lastly we have the vital action of animals which is commonly called life. Animals do not depend for their internal heat on direct external sources alone; but possess in the vital principle, as it is often called, the means of generating and maintaining in their bodies a suitable heat, which often differs in degree from that of the medium in which they live; but we must not forget that this cannot be kept up without material supplied from without. All heat of which we have any cognizance is the result of some form of combustion, and this is exactly true of the heat generated in the animal economy. The body may in some respects be compared to a furnace—of a curious character, certainly—wherein is kept up a constant combustion of fuel, not rapid, indeed exceedingly slow, and which takes place by the combination of the carbon of the blood, supplied to it in food, with the oxygen taken into the lungs by respiration. It thus occurs that if we run or practise any other muscular exertion, which quickens the circulation of the blood, we cause a more rapid combination of the carbon in the body, with the greater quantity of oxygen supplied by quickened respiration, and thus increase the heat of the body.

Having proceeded thus far in the consideration of this important subject, we are driven to conclusions arising therefrom. We see matter in its ultimate condition to consist of exceedingly minute, yet perfectly impenetrable atoms, each of which is inseparably connected with force in some form co-existent with the atom. Now perfect impenetrability involves most clearly *indestructibility*, and of this we have corroboration in many ways all around us. If we take a portion of any substance, and grind it to powder, it weighs still the same; if we collect all the particles and then burn the powder, collecting all the gases and ashes coming therefrom, they still weigh exactly the same as when in the more solid form; in fact the whole science of chemistry is based on the assumption of the indestructibility of matter, and both astronomy and mechanics are only compatible with the idea of indestructibility of force.

Now that which is indestructible in the present and future must be indestructible in the past; in other words, matter *only* receives creation so far as its *forms* are concerned. All *forms* of both matter and force are necessarily creations, and are, therefore, destructible. We see as a matter of experience that all observed facts agree with this; new forms being for ever evolved or created, and for ever being destroyed as such, destruction simply meaning *change*, existence being eternal.

From this point of view we surely obtain the highest possible conception of creative power, for ever ceaselessly at work, creating or designing new forms of an eternal and ever present universe of matter and force, which, apart from such creative operation would be truly without form and void.

W. G.

[Note.—In the last month's portion of the article on "Matter and Force," a very curious error occurs from an accidental transposition of words. The sense will be put right by transposing the words "its centre," in the 38th line of the 1st column on the 75th page, with the words "the globe" in the 42nd line.

MODERN GUNS AND PROJECTILES.

The U.S. Board of Engineers for Fortifications has recently submitted a valuable report upon the practice in Europe with the heavy Armstrong, Woolwich, and Krupp rifled guns. The conclusions of this report are as follows:—

"Experimental firings for penetration during the past twenty years have determined:

"1st. That wrought iron and cast iron, unless chilled, are unsuitable for projectiles to be used against iron armour; that the best material for that purpose is hammered steel or Whitworth's compressed steel.

"2nd. That cast iron and cast steel armour plates will break up under the impact of the heaviest projectiles now in service unless made so thick as to exclude their use in ship protection.

"3rd. That wrought iron plates have been so perfected that they do not break up, but are penetrated by displacement or crowding aside of the material in the path of the shot, the rate of penetration bearing an approximately determined ratio to the striking energy of the projectile, measured per inch of shot's circumference, as expressed by the following formula:—

$$\text{Penetration} = 2{\cdot}035\sqrt{\frac{V_2 P}{2g \times 2r\pi \times 2240 \times 0{\cdot}86}} \text{ in ins.}$$

V = velocity in feet per second; P = weight of shot in pounds; r = radius of shot in inches.

"That such plates can, therefore, be safely used in ship construction, their thickness being determined by the limit of flotation and the protection needed.

"4th. That though experiments with wrought iron plates faced with steel have not been sufficiently extended to determine the best combination of these two materials, we may nevertheless assume that they give a resistance about one-fourth greater than those of homogeneous iron.

"5th. That hammered steel in the late Spezia trials proved superior to any other material hitherto tested for armour plates. The 19 inch plate resisted penetration and was only partially broken up by four shots, three of which had a striking energy of between 33,000 and 34,000 foot tons each. Not one shot penetrated the plate. Those of chilled iron were broken up, and the steel projectile, though of excellent quality, was set up to about two-thirds of its length. This experiment seems to promise the solution of the problem to determine a material for armour plates which, though limited in thickness to the carrying capacity of the ship to be protected, will still have sufficient resistance to break up the projectiles of the largest guns now in the naval service, without being penetrated or broken by the projectile.

"It seems probable that a hammered steel plate, like that tried at Spezia, if equal in thickness to the belt armour of the Inflexible (22 inches), would stop the shot of the 100 ton gun (Armstrong) fired with its greatest practicable velocity.

"Finally, these later experiments confirm this Board in its opinion, enunciated some years since, that, while the 12 inch rifled gun may prove a sufficient armament for the barbette batteries of our sea coast defences, as against the lighter ironclads of foreign navies, iron turrets, armed with guns of 100 tons weight at least, will be needed to meet the attack of armoured ships of the latest construction."

The 100 ton chambered Armstrong gun, throwing a projectile of a ton weight, and fired with a charge of over 700 pounds of powder, may be taken as a sample of the monstrous requirements of modern war. Such guns must be both made and operated by machinery.

RECENT AMERICAN AND FOREIGN PATENTS.

An improved *steam brake* for locomotives has been patented by Mr. W. B. Wallace, of Belleville, Ill. The mechanism by means of which power is applied to the brakes consists of a steam cylinder open at one end and closed at the other, and provided with a piston to which is attached one end of the chain which actuates the brake. Wherefore when steam is admitted to the cylinder through the steam ports at its closed end, the piston will be projected and the brake set.

An improved *governor for steam engines* has been patented by Mr. William Knowles, of Bolton, County of Lancaster, England. Instead of employing the ordinary ball governor for controlling the action of the throttle valves and cut-offs of the engine, Mr. Knowles has interposed between the main governor and the valve a regulating governor which operates automatically, and serves to accelerate the action of the governor on the cut-off, and reduce to a minimum the variation in the speed of the engine.

In sinking driven *wells* where the water-bearing stratum is more than twenty feet below the surface, it is customary to excavate the earth down to that distance, and then to drive the pipe from the bottom of this excavation. Mr. Jehyleman Shaw, of Bridgeport, Conn., has obtained a patent for an improvement upon this method, which avoids the necessity of excavating. In some cases a large pipe is driven the whole distance to the water bearing stratum, while in others both a large and small pipe suitably coupled together are employed, as well as a pump valve or plunger that is adapted to work both upon the suction and lift principles.

A balanced *rotary valve* is the subject of a patent granted to Mr. Abiel E. Wilson, of Worcester, Mass. The invention consists in a double valve carried by a single stem and formed with ports combined with a body or case for use with regulators for either steam, water, or air, and is applicable for any situation where a frictionless valve is necessary. The two valves are balanced by the pressure of water or other fluid, and consequently there is little or no friction even under heavy pressure. The valves may be rocked by slight variations in pressure in the regulator. The valve case is to be connected in a water supply pipe for regulating the discharge and pressure, and having the stem connected to a pressure diaphragm in any suitable manner.

Mr. John Strachan, of New York city, has obtained a patent for an improved method of bushing the flue openings of steam boiler heads, which consists in an unflared ring of soft metal, and driving this ring into the flue opening of the boiler head, and finally expanding the ring in the opening, whereby the inner walls of the ring will always be in the form of a true circle, insuring always a perfect fit with the ends of the boiler flues.

An improved *rotary filing machine*, the object of which is to make a uniformly smooth surface on metal articles especially applicable for making rules has been patented by Mr. De Loss H. Stephens, of Riverton, Conn. The slide upon which the rule is placed, and the frame which carries the slide, are located at the outer edge of the wheel, and the joint to be filed is carried against the wheel, where the cut will be made in lines nearly parallel with the sides of the rule. The slide is actuated by a foot treadle.

A *magnetic separator*, intended for separating iron sand from common sand, the object being to obtain as large a percentage as possible of the ore free from other sands, has been patented by Mr. Joseph La B. Viger, of Montreal, Canada. The invention consists in an endless travelling apron combined with a series of magnets placed at an inclination, so that as the sand is fed to the side of the apron the magnetic particles will be retained thereon and carried forward to the discharge end, while the common sand will fall through into a waste receiver below.

An improved *surgeon's operating chair*, which is so constructed that the patient may be brought into any desired position, has been patented by Mr. F. Adon Krill, of

Burton, O. This chair is of simple construction, and the position of the various parts may be readily changed to suit the requirements of the case. In fact it is capable of about as many adjustments as a chair one of our contemporaries mentioned the other day, in which it said : man has invented a chair that can be adjusted to 800 different positions. It is designed," the wag adds, "for a boy to sit in when he goes to church."

The fact of a new *ice creamer* having been invented is in itself a refreshing announcement these hot days. But more than that, Messrs. William Rogers and Thomas A. Maher, of New Orleans, La., have patented what seems to be an excellent improvement in this useful article, by which the old and tiresome method of rotating the can is avoided. The ice freezing vessel in the new invention is provided with a central ice chamber open throughout its full diameter at both ends. Experience has satisfied the inventors that, from the large amount of freezing surface to which the cream is exposed, by simply charging the freezer with ice and salt and placing the cream therein, the latter will become frozen without any manipulation of the machine, thus avoiding much labour.

A simple *cultivator*, adjustable according to the work to be done, has been patented by Mr. G. W. Hammond, of Earl Park, Ind. It is so constructed that the machine is drawn over every other row and cultivates the entire space between that row and the adjacent one upon each side, so that the machine will cultivate four rows at each round.

LAVOISIER AND MODERN SCIENCE.

By G. F. Rodwell.

This memoir, which we find in the *Revue Scientifique* for May 26, 1883 (3e Série, 3e Année, No. 21) is of such grave importance for the history of chemical science that it fitly requires careful notice. It is nothing less than an able and successful vindication of the scientific merit of Lavoisier, and a refutation of certain charges which have been commonly brought against him. He has been commonly and very emphatically accused of appropriating the discoveries of his contemporaries. Thus Dr. Thomson, in his well-known "History of Chemistry," states that Lavoisier claimed the discovery of oxygen gas for himself, but that his claim merits no notice, as Priestley had shown him the process in 1774, "long before the date assigned by Lavoisier to his pretended discovery." It is said that, though he had been informed by Cavendish of the composition of water, he nevertheless sought to appropriate this discovery. On this subject James Watt, who also puts in a claim to have first observed the compound nature of water, wrote in 1784:—"Immediately after the appearance of my memoir of this subject Dr. Blagden explained my theory to M. Lavoisier, at Paris, and shortly after M. Lavoisier discovered it himself, and presented a memoir on the subject to the Academy of Sciences. Since then Mr. Cavendish presented to the Royal Society a memoir on the same subject without making mention of me. The one is a French financier, whilst the other belongs to the illustrious house of Cavendish. The great sometimes commit paltry actions." It will not be deemed out of place if we pronounce it utterly inconceivable that a man so regardless of the honour accruing from his own discoveries—and who often did not think it worth while to make them known—should appropriate those of others.

Brande seems to apologise for the sins of Lavoisier as due to haste and inadvertence, and Liebig omits his name among the founders of the new era in chemistry.

Having thus summarised the principal charges against Lavoisier, we turn to Mr. Rodwell's reply. He points out the erroneous nature of the assumption that Lavoisier first referred to the existence of oxygen and the composition of air and of water in his "Traité de Chemie," published in 1789. Hence many authors have supposed that his experiments on this subject had then been but recently made. But he mentions oxygen and the nature of the air twelve years earlier, in a paper read before the Academy, May 3rd, 1777, and bearing the title "On the Respiration of Animals, and on the Changes which Air Undergoes in Passing through their Lungs." It further appears that he had obtained oxygen, by means of the red precipitate of mercury, more than two-and-a-half years before the date of the paper. This brings us to some time in the year 1774. Now Priestley did not obtain oxygen until August in the same year, so that the difference in date is very trifling.

Dr. Thomson, in his "History of Chemistry," criticising Lavoisier's "Opuscules Physiques et Chimiques," published, it must be remembered, early in 1774, and bearing date December 3rd, 1773, says :—"Nothing in these researches indicates that Lavoisier suspected air to be a mixture of two distinct fluids, one of which only intervenes in combustion and calcination. Yet Priestley had already deduced this fact from his own experiments, and Priestley had discovered the existence and the characteristic properties of oxygen gas." But in the "Opuscules" Lavoisier shows distinctly that air is composed of two fluids, one of which is absorbed during calcination. This announcement was not merely prior to Scheele's deduction of the composition of air from his own experiments, and even eight months before Priestley obtained oxygen from the red oxide of mercury. "Thus," says Mr. Rodwell, "the accusations of Dr. Thomson fall and disappear one after the other."

It has been often said that Lavoisier had the habit of using the ideas of others without acknowledgment. Mr. Rodwell, on examining Lavoisier's original memoirs, finds that he was constantly and scrupulously careful in his referring to the works of other authors. Thus in 1776 Lavoisier wrote :—"I will begin by informing the public that a part of the experiments contained in this memoir do not in strictness belong to me; perhaps, correctly speaking, there is none of them of which M. Priestley might not claim the original idea, but as the same facts have led us to conclusions diametrically opposite, I hope that if anyone reproaches me for having borrowed proofs from the works of this celebrated physicist my claim to the conclusions will not be contested."

In the same year, in a treatise on muriatic acid, ammonia, and sulphurous acid, he writes—"The experiments of which I have just given an account belong almost all to Dr. Priestley; I have merely the merit of having repeated them with care, and above all of having arranged them in an order suitable for showing their consequences."

Again, in 1777, in a memoir on "Respiration," Lavoisier writes that Priestley, "by means of highly ingenious, very delicate, and novel experiments," has endeavoured to prove that respiration phlogisticates the air like calcination.

The passages just quoted are certainly not couched in the language of a systematic plagiarist,—an appropriator of the merits of others.

But we must pass on to the main accusation. What foundation have the detractors of Lavoisier for maintaining that he laid any dishonest claim to the discovery of oxygen? He writes in his "Traité de Chemie":—"This air which M. Priestley, M. Scheele, and myself have discovered almost simultaneously."

Further, in 1782, in a work entitled "Sur un Moyen d'Augmenter considérablement l'Action du feu et de la Chaleur dans les Opérations Chimiques," Lavoisier, speaking of oxygen, says:—"This gas, which M. Priestley discovered about the same time as I myself, and indeed, I believe, before me." Here, then, Lavoisier, so far from claiming anything not his own, explicitly admits Priestley's priority in all that was justly his due. For we must bear in mind that for some months Priestley was completely ignorant of the nature of the gas which he had discovered. In October, 1774, and even later, he believed that it was ordinary air containing "nitrous corpuscules." Even to his death he remained a determined partisan of the phlogiston theory. Consequently he never rightly understood the part played by oxygen, whether in the chemistry of nature or of art.

Having arrived at this point, Mr. Rodwell raises the question, what is the true sense of the words "discovery" and discoverer"? Is the discoverer the man who first sees or produces a new fact, a novel phenomenon, or rather the man who first recognises its nature and its relations with other facts? Mr. Rodwell reminds us that nearly 300 years before Priestley, Eck, of Sulzbach, noted the increase of weight of mercury when submitted to oxidation—or, as it was then called, to calcination—and on submitting this "calx" to a higher temperature he obtained "a spirit," evidently oxygen gas. Hence Priestley did not find the ground entirely unoccupied.

Our author calls also to mind that Robert Hooke, and still more Robert Mayow, came much closer upon the theories of Lavoisier than ever did Priestley. If Hooke's twelve propositions on combustion had not been buried in a book on microscopic discoveries little likely to be studied by chemists, and if Mayow had not died at the early age of 34, it is not improbable that the Phlogistian system might never have originated, and that Lavoisier, starting on a higher plane, might have been able to devote his splendid genius to yet more important tasks than those which fell to his lot. Be this as it may, we cannot but rejoice to find the reputation of this illustrious chemist effectually cleared from the charges of plagiarism which have been brought against him. Mr. Rodwell observes, in conclusion, that it would be impossible to compare two minds more fundamentally opposite than Lavoisier and Priestley. "The latter experimented at random and made his discoveries, so to speak, by accident. Lavoisier worked methodically, and his results often confirmed his theories. Priestley was an obstinate upholder of phlogiston, and refused to abandon it long after its falsehood had been recognised by the *savants* of Europe. Lavoisier, by the most beautiful series of deductions, overturned this theory, which his predecessors had so long accepted, and on its ruins he erected a monument henceforth imperishable."—*Chemical News.*

Liquefied Carbonic Acid.—The use of liquefied carbonic acid in the preparation of carbonated beverages is recommended by Mr. Apotheker Volk, of Rateburg, who states that experiments have proved it to be the purest, most suitable, and best method of impregnating mineral waters. It is also claimed that by using the carbonic acid in this form the more expensive part of the apparatus now used in the manufacture could be dispensed with. It is evident, however, that even should a sufficiently cheap supply of pure liquefied carbonic acid be forthcoming, special precautions will have to be adopted as to the containing vessels and the manner in which they are stored, as the gas requires at 0° C. for its liquefaction a pressure of 36 atmospheres, which increases rapidly with a rise of temperature. It would be worth while to carry the experiment a little further and try the solidified acid, the relatively slow evaporation of which, even when exposed to the air, might facilitate manipulation.

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